Device for Acting on a Flowing Gas with a Reactant

The current invention relates to a device for acting on a flowing gas, in particular an exhaust, with a reactant, in particular a reducing agent~~, according to the preamble to claim 1~~.

Description of the Prior Art

In order to reduce emissions levels in motor vehicles, extensive advances have been made in catalytic converter technology, in particular in order to reduce nitrogen oxides in exhaust. Reduction catalytic converters have turned out to be particularly promising in this connection.

As a device for aftertreatment of exhaust, for example, EP-A-0 381 236 has disclosed a system in which ammonia or urea is added to the exhaust as a reducing agent. In this known system, the reducing agent is sprayed via an injection valve into a premixing chamber which feeds into the exhaust pipe leading to the reduction catalytic converter. In a device of this kind, in order to introduce a reducing agent into an exhaust pipe section of an internal combustion engine, which pipe leads to a reduction catalytic converter, the premixing chamber constitutes a reducing agent line that feeds into the exhaust pipe.

~~Although~~ a part of the reducing agent is atomized in the mixing chamber or mixing section, a wall film forms. If the atomizing tube depicted there is used, an uneven wall film

decomposition occurs in the vicinity of turns - particularly when small reducing agent quantities are used. This is due to the fact that in the inner and outer regions of the tube bend, there are different flow speeds of the air, exhaust, or other carrying medium which is used to transport the reducing agent. A favorable equidistribution of the reducing agent in the entire operating range of the system is therefore not assured. This results in poorer conversion rates in the catalytic converter.

DE-A-1 196 25 447 has disclosed a device for aftertreatment of exhaust of an internal combustion engine in which in order to promote the action of a subsequent reduction catalytic converter, fuel is admeasured as a reducing agent by means of a metering valve and is introduced into the exhaust valve via an evaporating device. The evaporating device is a metal sleeve which is provided with a glow element and has a through opening on its end face, through which the evaporated reducing agent is introduced into the exhaust flow. In this system, the evaporation of the reducing agent is in fact thermally encouraged, but this embodiment is technically difficult to achieve and requires a high expenditure of energy to heat and evaporate the reducing agent.

~~Therefore the~~ A primary object of the invention is to produce a device for acting on a flowing gas, in particular an exhaust, with a reactant, in particular a reducing agent, with which a favorable aerosol formation occurs in the greatest possible

characteristic field range so that the overall efficiency of the reaction system, in particular of a catalytic converter system, is increased and so that lower NO_x emissions, for example, can be achieved.

This object is attained by means of a device with the characteristics of claim 1.

The device according to the invention makes it possible for a flowing gas, in particular an exhaust, to be acted on with reactants or reducing agents more uniformly than is possible with conventional designs. The more uniform reactant or reducing agent distribution that is assured according to the invention makes it possible, for example in catalytic converter systems, to achieve significantly better conversion rates than in conventional systems, even with the introduction of relatively small reducing agent quantities into an exhaust to be aftertreated catalytically.

Advantageous embodiments of the device according to the invention are the subject of the dependent claims.

According to a particularly preferred embodiment of the device according to the invention, the means for uniformly distributing the reactant are embodied as screens or throttles inserted into the tube. A screen or throttle of this kind can be obtained for very little expense and can easily be inserted

into a desired location in the supply or metering tube of the reactant.

According to a suitable modification of the device according to the invention, the supply tube has a first region extending essentially perpendicular to the flow direction of the flowing gas and a second region extending essentially parallel to the flow direction of the flowing gas, wherein the openings via which the reactant can be introduced from the supply tube into the flowing gas are embodied in a section of the tube wall of the second region and the means for uniform distribution of the reactant are provided immediately upstream of this section. It turns out to be simple to mount a supply tube of this form in an exhaust line through which an exhaust flows. The addition of the reducing agent, for example in an exhaust system, takes place, for example, in commercial vehicles with compressed air support, i.e. the reducing agent to be supplied is transported through the supply tube by means of compressed air. Particularly with small reducing agent quantities, different flow speeds at the turning point of the supply tube (transition between the first and second region of the supply tube) lead to an uneven wall film decomposition of the reducing agent. Usually in the past, the reducing agent only came out of a part of the openings at the end of the supply tube, as a result of which a favorable equidistribution in the entire operating range of the system was no longer assured. According to the invention, this uneven wall film decomposition is now compensated for by virtue of the fact

that, for example with the use of a screen or throttle, the reducing agent is once again concentrated in the center of the spray tube and then, driven by the above-mentioned compressed air, can be introduced into the exhaust flow uniformly in the form of an aerosol by means of the outlet bores.

Suitably, a number of openings are provided, which are distributed uniformly around the circumference of the tube. The cooperation of the means for uniform distribution of the reactant with such uniformly disposed openings permits reactants to act on a flowing gas in a particularly uniform manner.

The ~~invention will now be explained in~~ detail in conjunction with the accompanying ~~drawings,~~ IN WHICH;

Fig. 1 shows a schematic, sectional side view of a preferred embodiment of the device according to the invention and

Fig. 2 shows an enlarged view of the region X in Fig. 1.

In Fig. 1, the wall of an exhaust pipe section 10 is shown in which exhaust from an internal combustion engine is conveyed to a reduction catalytic converter. The flow direction of the exhaust is indicated by the arrow p. A supply tube 1 feeds into the exhaust pipe section 10 and reducing agent from a reducing agent tank (not shown) can be introduced

into the exhaust pipe section via this supply tube. In addition to hydrocarbons, for example diesel fuels among others, in particular urea-water solutions can be considered for use as the reducing agent and can be introduced into the supply line, for example by means of an injection nozzle, a gasifying device, or other metering devices.

In an intrinsically conventional manner, the supply line 1 inside the exhaust pipe has a first region 1a extending essentially perpendicular to the flow direction of the exhaust, a second region 1b extending essentially parallel to the flow direction of the gas, and a bending region 1c that connects the regions 1a and 1b. The region 1b of the supply tube is suitably disposed in the center of the exhaust pipe and extends in a direction that corresponds at least approximately to the exhaust flow in the exhaust pipe.

At the downstream end of the supply tube 1, there is a section labeled X, which is shown in an enlarged scale in Fig. 2. In this region X, embodied on the circumference of the wall of the tube section 1b, the supply tube 1 has a number of openings 2 via which reducing agent can travel from the supply tube 1 into the exhaust pipe. Before these openings 2 in the ~~downstream~~ UPSTREAM direction, there is a throttle 3, which has a throttle opening 3a in the center. The function of this throttle 3 in operational connection with the openings 2 will be explained below.

The supply tube 1 is fastened to the wall 10 of the exhaust pipe, for example by means of a screw connection 11.

When the atomizing tube depicted is used, an uneven wall film decomposition occurs in the vicinity of the bend - particularly when small reducing agent quantities are used. This is due to the fact that in the inner and outer regions of the tube bend, there are different flow speeds of the air, exhaust, or other carrying medium which is used to transport the reducing agent. A favorable equidistribution of the reducing agent in the entire operating range of the system is therefore not assured. This results in poorer conversion rates in the catalytic converter.

The throttle 3 serves to concentrate the wall film in the center of the spray tube, as a result of which the effect of interrupted wall films can be compensated for. The reducing agent concentrated in the center of the tube 1 by means of the throttle 3 is pushed through the central opening 3a of the throttle by means of the compressed air mentioned above, which causes the reducing agent to uniformly act on the openings 2.

In summary it is clear that through the use of the throttle 3, the quality of the aerosol formation is sharply improved in comparison to conventional embodiments so that the total efficiency of the system, i.e. the NO_x reduction can be improved in comparison to conventional embodiments. The system can be adjusted to different requirements or engines by means

of parameters relating to the arrangement, size, and number of openings 2 and relating to the dimensions of the central opening 3a of the throttle 3.